ANALOG

SSI

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LLB-65 (H) / LLB-500 (H)

LLB65-00600
LLB65-00601
LLB65-00610
LLB65-00611
LLB500-00600
LLB500-00601
LLB500-00610
LLB500-00611

- **Software/Support CD: 490-01001**
  - **Soft-No.: LLB Utility**

Benutzerhandbuch / *User Manual*

Laser-Entfernungs-Messgerät / *Laser Measuring Device*

LLB-65 (H) Analog

LLB-500 (H) Analog + SSI

TR - ELE - BA - DGB - 0021 - 01 10/19/2010

User Manual

Laser Measuring Device
LLB-65 (H) Analog
LLB-500 (H) Analog + SSI

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Revision	Date	Index
First release	4/27/2010	00
Vibration and shock added to the technical data	10/19/2010	01

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1 General information

The User Manual includes the following topics:

- Basic safety instructions
- Introduction
- Device setup
- Installation
- Technical data
- Electrical components
- Physical dimensions
- Factory settings
- Command set
- Accessories

As the documentation is arranged in a modular structure, this User Manual is supplementary to other documentation, such as product datasheets, dimensional drawings, leaflets etc.

The User Manual may be included in the customer's specific delivery package or it may be requested separately.

1.1 Applicability

This User Manual applies exclusively to the following measuring system series with

- **Analog** interface

- LLB65-00600
- LLB65-00601
- LLB65-00610
- LLB65-00611

- **Analog + SSI** interface

- LLB500-00600
- LLB500-00601
- LLB500-00610
- LLB500-00611

The products are labelled with affixed nameplates and are components of a system.

The following documentation therefore also applies:

- the operator's operating instructions specific to the system,
- this User Manual

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1.2 EC Declaration of conformity

The measuring systems have been developed, designed and manufactured under observation of the applicable international and European standards and directives.

A corresponding declaration of conformity can be requested from TR-Electronic GmbH.

The manufacturer of the product, TR-Electronic GmbH in
D-78647 Trossingen, operates a certified quality assurance system in accordance with ISO 9001.

1.3 Abbreviations and definitions

EC	***E***uropean ***C***ommunity
EMC	***E***lectro ***M***agnetic ***C***ompatibility
ESD	***E***lectro ***S***tatic ***D***ischarge
IEC	***I***nternational ***E***lectrotechnical ***C***ommission
LLB	Laser Measuring Device
VDE	German Electrotechnicians Association

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2 Basic safety instructions

2.1 Definition of symbols and instructions

WARNING !	Means that death, serious injury or major damage to property could occur if the stated precautions are not met.
CAUTION !	Means that minor injuries or damage to property can occur if the stated precautions are not met.
WARNING !	Means that eye injury can occur from laser light if the stated precautions are not met.
	Indicates important information's or features and application tips for the product used.

2.2 Obligation of the operator before start-up

As an electronic device the measuring system is subject to the regulations of the EMC Directive.

It is therefore only permitted to start up the measuring system if it has been established that the system/machine into which the measuring system is to be fitted satisfies the provisions of the EC EMC Directive, the harmonized standards, European standards or the corresponding national standards.

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2.3 General risks when using the product

The product, hereinafter referred to as **"the measuring system"**, is manufactured according to state-of-the-art technology and accepted safety rules. **Nevertheless, improper use can pose a danger to life and limb of the user or third parties, or lead to impairment of the measuring system or other property!**

Only use the measuring system in a technically faultless state, and only for its designated use, taking safety and hazard aspects into consideration, and observing this **User Manual**! Faults which could threaten safety should be eliminated without delay!

2.4 Proper use

The measuring system is used to measure distances and to condition the measurement data for the subsequent control of industrial control processes.

Proper use also includes:

- observing all instructions in this User Manual,
- observing the nameplate and any prohibition or instruction symbols on the measuring system,
- observing the enclosed documentation, e.g. product insert, connector configurations etc.,
- observing the operating instructions from the machine or system manufacturer,
- operating the measuring system within the limit values specified in the technical data.

The following areas of use are especially forbidden:

- in areas in which interruption of the laser beam can cause damage or personal injury, for example by covering the laser lens opening,
- in environments where heavy rain, snow, fog, vapours or direct sunlight etc. can impair the laser intensity,
- in environments where there is an explosive atmosphere,
- for medical purposes

WARNING !

Where there is a danger of physical injury and damage to property arising from jumps in the position of the measuring system!

- As the measuring system **does not constitute a safety component**, a plausibility check of the measuring system values must be performed through the subsequent control system.
- It is mandatory for the operator to integrate the measuring system into his own safety concept.

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2.5 Warranty and liability

The General Terms and Conditions ("Allgemeine Geschäftsbedingungen") of TR-Electronic GmbH always apply. These are available to the operator with the Order Confirmation or when the contract is concluded at the latest. Warranty and liability claims in the case of personal injury or damage to property are excluded if they result from one or more of the following causes:

- Non-designated use of the measuring system.
- Improper assembly, installation, start-up and programming of the measuring system.
- Incorrectly undertaken work on the measuring system by unqualified personnel.
- Operation of the measuring system with technical defects.
- Mechanical or electrical modifications to the measuring systems undertaken autonomously.
- Repairs carried out autonomously.
- Third party interference and Acts of God.

2.6 Organizational measures

- The User Manual must always be kept accessible at the place of use of the measuring system.
- In addition to the User Manual, generally applicable legal and other binding accident prevention and environmental protection regulations are to be observed and must be mediated.
- The respective applicable national, local and system-specific provisions and requirements must be observed and mediated.
- The operator is obliged to inform personnel on special operating features and requirements.
- The personnel instructed to work with the measuring system must have read and understood the User Manual, especially the chapter “Basic safety instructions” prior to commencing work.
- The nameplate and any prohibition or instruction symbols applied on the measuring system must always be maintained in a legible state.
- Do not undertake any mechanical or electrical modifications on the measuring system, apart from those explicitly described in this User Manual.
- Repairs may only be undertaken by the manufacturer or a facility or person authorized by the manufacturer.

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2.7 Personnel qualification; obligations

- All work on the measuring system must only be carried out by qualified personnel.

  Qualified personnel includes persons, who, through their training, experience and instruction, as well as their knowledge of the relevant standards, provisions, accident prevention regulations and operating conditions, have been authorized by the persons responsible for the system to carry out the required work and are able to recognize and avoid potential hazards.

- The definition of “Qualified Personnel” also includes an understanding of the standards VDE 0105-100 and IEC 364 (source: e.g. Beuth Verlag GmbH, VDE-Verlag GmbH).

- Define clear rules of responsibilities for the assembly, installation, start-up and operation. The obligation exists to provide supervision for trainee personnel !

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2.8 Safety information's

Eye injury from laser radiation!

WARNING !

- The measuring system functions with a red light laser Class 2. In the case of Class 2 laser devices, the eye is not endangered if the exposure to the laser radiation is very brief (up to 0.25 s) and accidental. For this reason, devices of this class can be used without additional protective measures, provided the application does not require one to look into the laser beam deliberately for longer periods, i.e. 0.25 s, or to look repeatedly into the laser beam or the reflected laser beam.

  The existence of the blinking reflex for the protection of the eyes may not be assumed. Therefore eyes should be closed consciously, or the head should be turned away immediately!

- The measuring system must be installed in such a way that the exposure of persons to the laser beam can only occur accidentally.

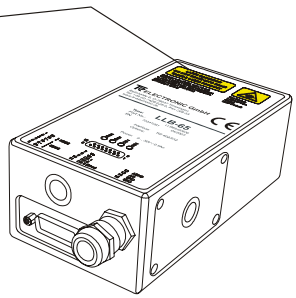
- The laser beam must only extend as far as is necessary for the range measurement. The beam must be limited at the end of the useful range by a target area in such a way as to minimize the danger from direct or diffuse reflection.

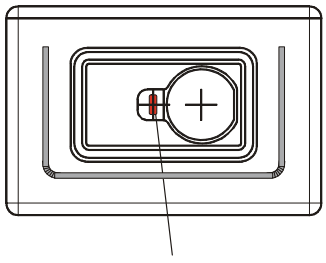
- The area outside the operating range where the unshielded laser beam falls should be limited as far as possible and should remain out of bounds, particularly in the area above and below eye level.

- Heed the laser safety regulations according to DIN EN 60825-1 in their most current version.

- Observe the legal and local regulations applicable to the operation of laser units.

Laser warning symbol





Laser beam outlet

Laser specifications:

Laser protection class:	2 accor. IEC 60825-1 / FDA 21 CFR 1040.10, 1040.11
Wavelength:	620-690 nm
Beam divergence:	0.16 x 0.6 mrad
Pulse duration:	0.45 x 10^{-9} s
Max. radiant power:	0.95 mW

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WARNING !

- ***Danger of physical injury and damage to property !***
  - Do not point the viewfinder directly at the sun, the viewfinder functions as a magnifying glass and can injure eyes and/or cause damage inside the LLB.
  - De-energize the system before carrying out wiring work or opening and closing electrical connections.
  - Do not carry out welding if the measuring system has already been wired up or is switched on.
  - Ensure that the laser warning symbol on the measuring system is well visible anytime.
  - No use of accessories from other manufacturers.

CAUTION !

- Ensure that the area around the assembly site is protected from corrosive media (acid, etc.).
- Do not open the measuring system.

- ***Disposal***
  If disposal has to be undertaken after the life span of the device, the respective applicable country-specific regulations are to be observed.
- ***Cleaning***
  Clean the lens opening of the measuring system regularly with a damp cloth. ***Do not use any aggressive detergents, such as thinners or acetone!***

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3 Introduction

The LLB (optional LLB (H = with heating) is a powerful distance-measuring instrument for integration into industrial applications. It allows accurate and contactless distance measurement over a wide range using the reflection of a laser beam:

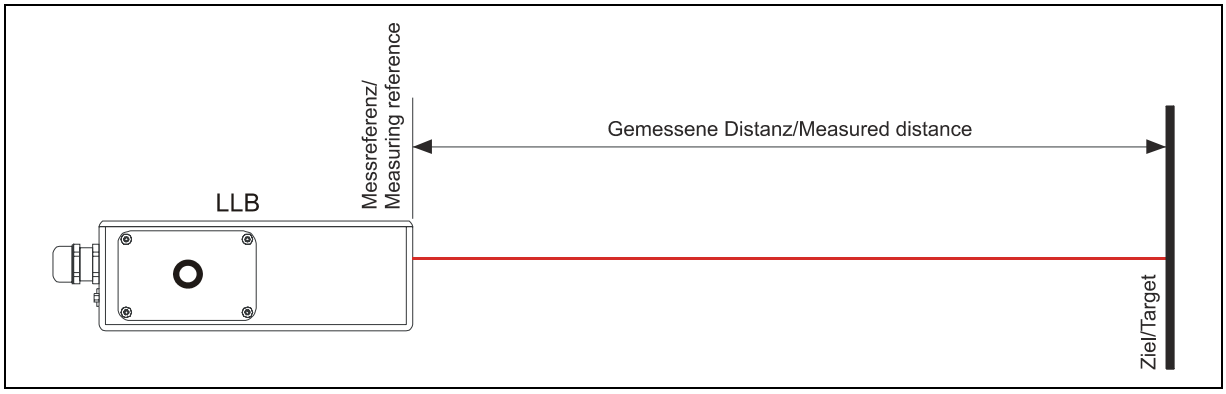

Figure 1: Standard application

Key features:

- Compatible with TR LLB-60 Laser Distance Sensor
- LLB-65 / LLB-500 measurement range on natural surfaces 0.05 m up to approx. 65 m
- LLB-500 measurement range on (reflective) target plate 0.05 m up to approx. 500 m
- Serial interface (RS232 and RS422)
- SSI interface (LLB-500 only)
- Connection of up to 10 modules on a single RS422 line
- Wide range power supply (9...30 VDC), heating option (24...30 VDC)
- Programmable analog output (0/4...20 mA)
- Two programmable digital outputs (DO1 and DO2)
- Digital output for error signalization (DOE)
- One programmable digital input (DI1)
- ASCII protocol to control external displays
- D-Sub connector and screw terminal joint for easy connection
- IP65 (protected against ingress of dust and water)
- 4 LEDs for status signalling
- Complementary configuration software available at web site www.tr-electronic.de or Support CD
- Optional: Internal heater for module operation down to -40 °C
- Laser class II (<0.95 mW)
- Accessories for easy use of the sensor

For easy startup with the device, please use the free configuration software from our web-page: http://www.tr-electronic.de/ or Support CD

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3.1 Product identification

The product is identified by the label on the top of the enclosure:

LLB-65 Version with a measuring rate of up to 6 Hz.

Version	*Typical Accuracy*	
	1.5 mm	***3 mm***
Standard version	LLB-65 Part No.: LLB65-00600	LLB-65 Part No.: LLB65-00601
Extended temperature range	LLB-65 (H) Part No.: LLB65-00610	LLB-65 (H) Part No.: LLB65-00611

LLB-500 Version with a measuring rate of up to 25 Hz.

Version	*Typical Accuracy*	
	1 mm	***3 mm***
Standard version	LLB-500 Part No.: LLB500-00600	LLB-500 Part No.: LLB500-00601
Extended temperature range	LLB-500 (H) Part No.: LLB500-00610	LLB-500 (H) Part No.: LLB500-00611

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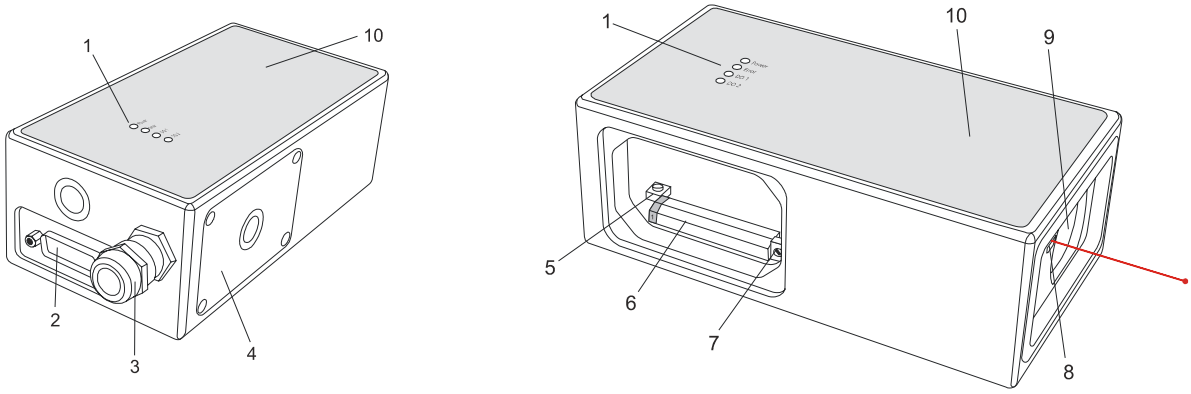
3.2 Components



1 Status LEDs
status signalling

2 15-Pin D-Sub connector
RS422, RS232, SSI, analog, digital output

3 Cable gland (M16 x 1.5 mm)
for connection cable insertion

4 Cover
provides access to electrical components

5 Reset switch
resets the LLB to default settings

6 Screw terminal
RS422, RS232, SSI, analog, digital output

7 ID switch
defines the module ID for RS422 operation

8 Laser beam outlet

9 Receiver optics

10 Product label
see 2.8 on page 65.

3.3 Validity

This manual is valid for LLB devices with the following software version:

Interface software version: **0100 or later**
Module software version: **0100 or later**

To get the software version for the LLB use the command described in 10.3.9 Get Software Version (`sNsv`) on page 94

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3.4 Measurement range

The LLB is an optical instrument, whose operation is influenced by environmental conditions. Therefore, the measurement range achieved in use may vary. The following conditions may influence the measurement range:

Influence	*Factors increasing range*	*Factors reducing range*
Target surface	Bright and reflective surfaces such as the target plates, see 11 Accessories on page 103.	Matt and dark surfaces green and blue surfaces
Airborne particles	Clean air	Dust, fog, heavy rainfall, heavy snowfall
Sunshine	Darkness	Bright sunshine on the target

The LLB does not compensate for the influence of the atmospheric environment, which may be relevant when measuring long distances (e.g. > 150m). These effects are described in:

B.Edlen: "*The Refractive Index of Air, Metrologia 2*", 71-80 (1966)

3.5 Prevention of erroneous measurements

3.5.1 Rough surfaces

On a rough surface (e.g. coarse plaster), measure against the center of the illuminated area. To avoid measuring to the bottom of gaps in the surface use a target plate, see 11 Accessories on page 103 or board.

3.5.2 Transparent surfaces

To avoid measuring errors, do not measure against transparent surfaces such as colourless liquids (such as water) or (dust-free) glass. In case of unfamiliar materials and liquids, always carry out a trial measurement.

Erroneous measurements can occur when aiming through panes of glass, or if there are several objects in the line of sight.

3.5.3 Wet, smooth, or high-gloss surfaces

1 Aiming at an "acute" angle deflects the laser beam. The LLB may receive a signal that is too weak (error message 255) or it may measure the distance targeted by the deflected laser beam.
2 If aiming at a right angle, the LLB may receive a signal that is too strong (error message 256).

3.5.4 Inclined, round surfaces

Measurement is possible as long as there is enough target surface area for the laser spot.

3.5.5 Multiple reflections

Erroneous measurements can occur in the case that the laser beam is reflected from other objects than the target. Avoid any reflecting object along the measurement path.

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4 Device setup

We recommend performing the configuration steps in an office before mounting the device, especially if you are not familiar with the LLB.

The LLB supports two types of operation modes:

- Controlled mode
- Automatic mode (for use in stand-alone operation)

The first decision to be taken is the type of operation mode that will be used to transmit the distance measurement data. While the controlled mode provides maximum flexibility and accuracy, it is often not suitable for integration into existing PLCs or analog environments. In such cases the automatic mode might be preferred.

Influence	*controlled mode*	*automatic mode (with analog output and/or digital outputs)*
Accuracy	Maximum measurement accuracy	Accuracy depends on signal scaling (see 10.3.5 Set/Get distance range (`sNv`) on page 92)
Flexibility	Access to full command set	Limited
Integration	Requires protocol implementation	Wiring of AO and/or DO signals
Connection	Connection of up to 10 LLB to a single RS-422 line.	Point-to-point connection

The following two sections describe the configuration of the LLB for the controlled and automatic modes.

4.1 Connection

To be able to configure the LLB, it must be powered and connected to a PC. Figure 2 shows the necessary connections. On the PC, any terminal program can be used to communicate with the module. A configuration utility is also available on the web page www.tr-electronic.de.

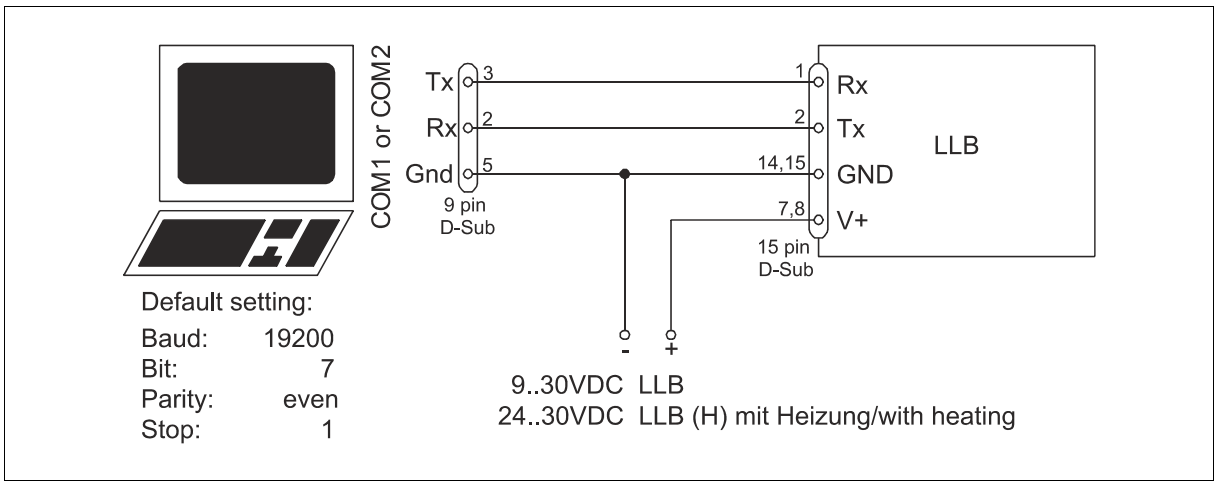

Figure 2: Connection for LLB configuration

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4.2 Controlled mode

In controlled mode, each operation of a LLB is triggered by a command sent from a host system over a serial line. While a single device can be connected to the host system using the RS232 interface, up to 10 devices can be connected to a single serial RS422 line. The related command set is described in Chapter 10 on page 86.

4.2.1 Configuration

After connecting the module, the steps below are necessary to configure the LLB for the controlled interface mode.

No.	*Action*	*Comment*	*Command*
1	Set ID switch	Changes of the module ID are activated after a power cycle. *Example for module 0:* Change the ID Switch to position 0	Set ID switch to position 0 Power OFF; Wait 10s; Power ON
2	Set controlled mode	Set the LLB to the controlled mode, if not already in controlled mode. *Example for module 0:* Set to controlled mode by means of the stop command.	`s0c<trm>`[1)]
3	Set communication parameters	If necessary, change the settings for the serial interface. *Example for module 0:* Set serial interface to 19200 Baud, 8 Bit, no Parity	`s0br+2<trm>`[1)] Power OFF; Wait 10s; Change settings on the host; Power ON

1) Commands are described in chapter 10 Command set on page 86

If the communication parameters of the module are lost, please reset the configuration to the factory settings (9 Factory settings on page 85) using the reset button (see 7.2 Reset switch on page 81). Please note that the ID switch must be reset manually.

4.2.2 Host software

Host software is required for operation of the LLB in controlled mode. When connecting multiple devices to a single serial line (RS422), strict Master-Slave communication must be implemented (LLB operates as slave).

WARNING !

- ***Danger of physical injury and damage to property by accidentally commands !***
  - Careful testing of the host software together with the devices prior to installation is strongly recommended.

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4.3 Automatic mode

The automatic mode is provided for host-less operation of the LLB. The analog and digital outputs are updated according the configuration described below as soon as the unit is powered up.

Analog Output

The analog output is configurable and works with two ranges:

- 0..20 mA
- 4..20 mA

Digital Outputs

Three digital outputs are included in the LLB. Two are programmable, while the third is used to signal an error state of the device.

4.3.1 Configuration

After connecting the module, the following steps are necessary to configure the LLB for automatic mode.

No.	Action	Comment	Command
1	Set current output range	Defines if the current output range from 0 to 20 mA or from 4 to 20 mA. *Example for module 0:* Set current output range from 4mA to 20 mA.	s0vm+1<trm>[1)]
2	Set distance range	Defines minimum distance (D_{min}) and the maximum distance (D_{max}) for the distance range of the analog output. *Example for module 0:* Set distance range from 0m to 10m	s0v+00000000+00100000<trm>[1)]
3	Set analog output in case of an error	Sets the current, that should be applied in case of an error. *Example for module 0:* Set current to 0 mA in case of an error.	s0ve+000<trm>[1)]
4	Configure digital output	Set the ON and OFF level for the digital outputs. *Example for module 0:* DO 1: off=2000 mm on=2005 mm DO 2: off=4000 mm on=4005 mm	s01+00020000+00020050<trm>[1)] s02+00040000+00040050<trm>[1)]

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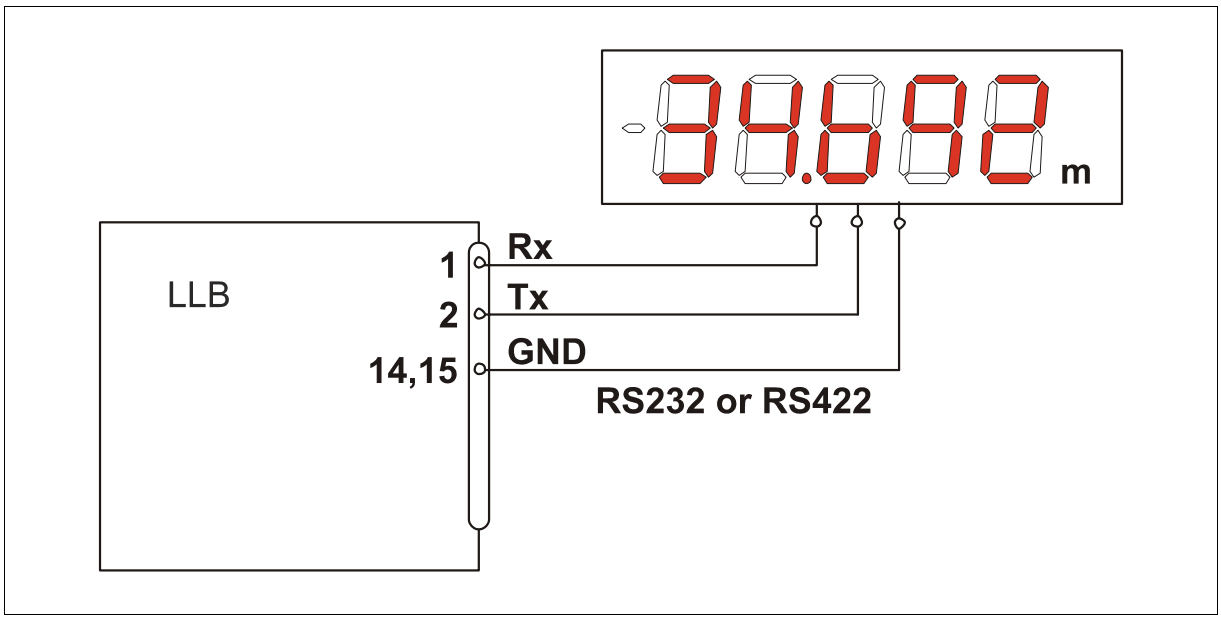
No.	Action	Comment	Command
5	Save settings	The changed configuration must be saved to make it permanent. *Example for module 0:* Save settings for module 0	s0s<trm>[1)]
6	Set automatic mode	Set the LLB to the automatic mode with the desired update rate. *Example for module 0:* Set measurement rate to fastest possible speed.	s0A+0<trm>[1)]

1) Commands are described in chapter 10 Command set on page 86.

If the communication parameters of the module have been lost, please reset the configuration to the factory settings (9 Factory settings on page 85) using the reset button (see 7.2 Reset switch on page 81). Please note that the ID switch must be reset manually.

4.4 Display Mode

If Display Mode is enabled, the LLB formats the measured distance as ASCII string, which is understood by External Displays with a serial interface. Since the LLB outputs this formatted string automatically on the serial interface after completing a measurement. Measurement results can be displayed on an external display without an additional controller.
For a detailed description of this mode, please contact TR-Electronic.



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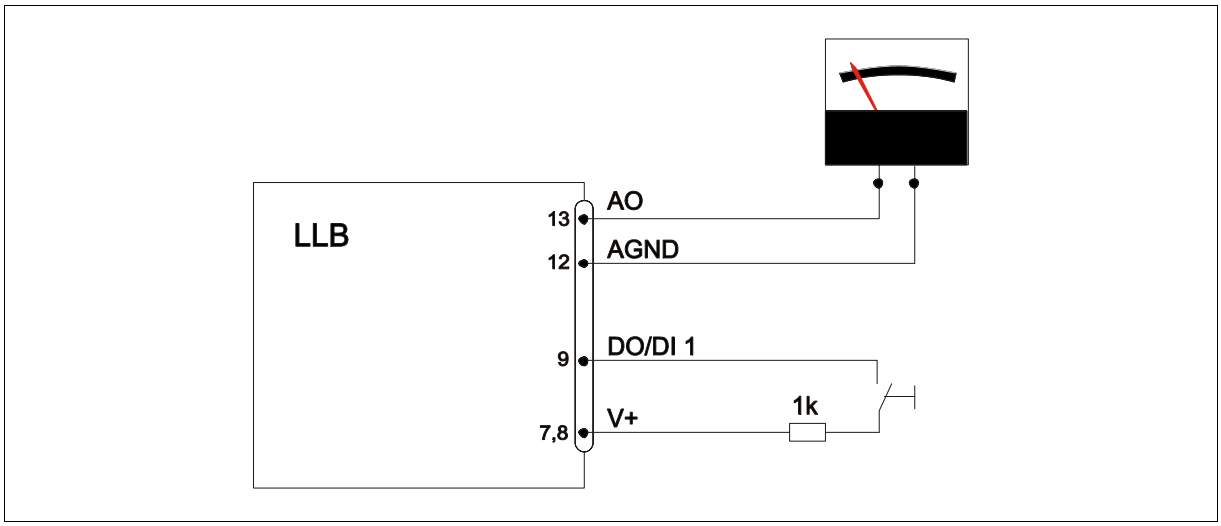
4.5 External Trigger

The LLB includes the option of triggering measurements with an external switch or push button on Digital Input 1 (DI 1). Using the Digital Input DI 1 disables the Digital Output DO 1.



The command to activate the external trigger option is described in 10.4 Digital Input on page 96.

4.5.1 Configuration

After connecting the LLB, the following steps are necessary to activate the external trigger. The example shows the configuration for triggering a single distance measurement.

No.	Action	Comment	Command
1	Activate digital input DI1	Defines the action for a trigger event on DI1. *Example for module 0:* Configure DI1 to trigger a single distance measurement.	`s0DI1+2<trm>`[1)]
5	Save settings	The changed configuration must be saved to make it permanent. *Example for module 0:* Save settings for module 0	`s0s<trm>`[1)]

1) Commands are described in 10 Command set on page 86

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5 Installation

5.1 Mounting

Three M4 threaded holes in the bottom of the LLB make it easy to mount the device.

5.2 Device wiring

5.2.1 Power Supply

For trouble-free operation use a separate power supply for the LLB.

- LLB: 9…30 VDC, 0.5 A
- LLB (H): 24…30 VDC, 2.5 A

5.2.2 Cable connection

A ferrite core must be fitted to the connecting cable. Use a ferrite core with an impedance of 150 Ω to 260 Ω at 25 MHz and 640 Ω to 730 Ω at 100 MHz. For example you can use KCF-65 from KE Kitagawa.

5.2.3 Shield and Ground

The LLB contains two electrically isolated grounds, the general ground (GND) and the analog ground (AGND). GND and AGND are connected to the housing by a RC element.
Please see Figure 3.

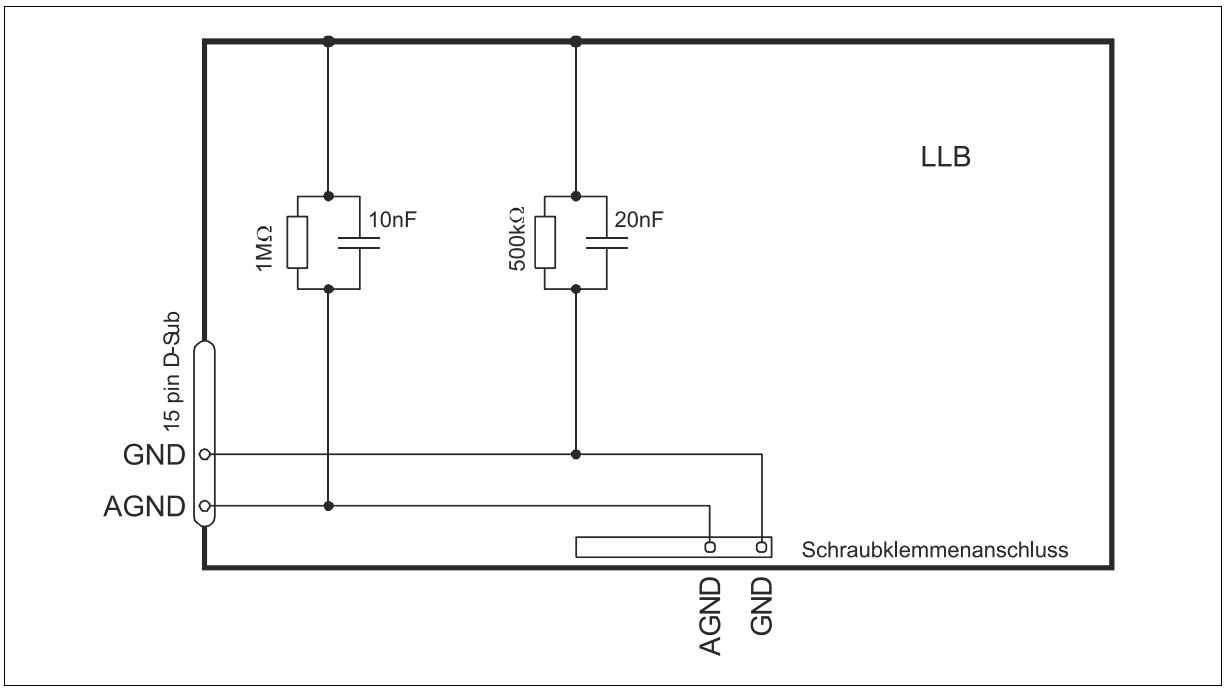

Figure 3: Connection between shield, Ground (GND) and Analog Ground (AGND)

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5.2.4 Controlled mode

RS232

WARNING !

- ***Danger of physical injury and damage to property by undefined interface states !***
  - Never connect multiple LLB´s on a RS232 serial line

Only point-to-point communication is possible when using the RS232 interface.

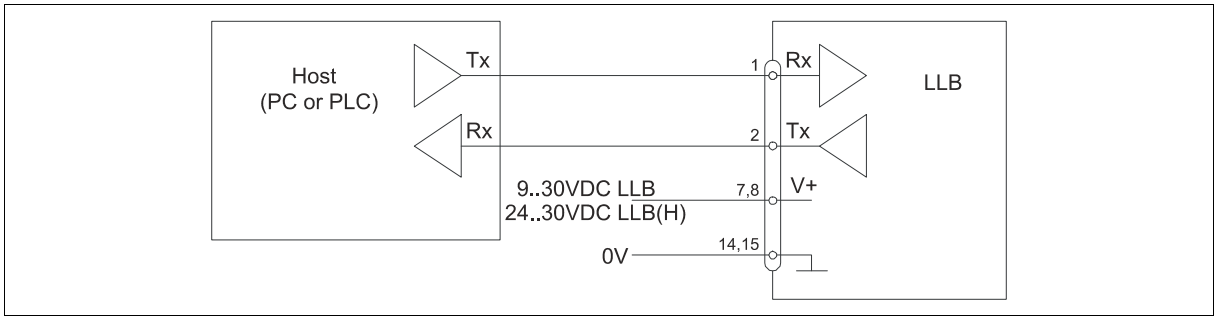

Figure 4: Point-to-point connection with RS 232

RS422

WARNING !

- ***Danger of physical injury and damage to property by undefined interface states !***
  - Ensure, that all LLB´s are set to different ID numbers

It is possible to connect multiple devices on a single RS422 line. To ensure proper operation, strict Master-Slave communication must be applied. It is important, that the Master has full control of the communication and never initiates a new communication before termination of the previous communication (answer from the LLB or timeout).

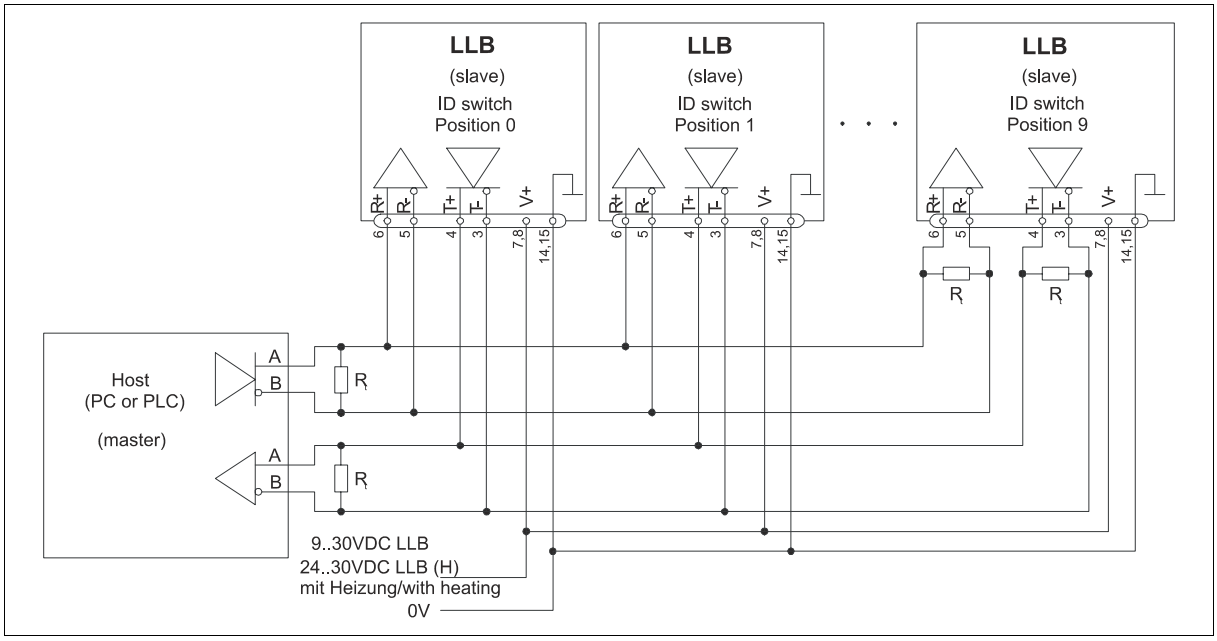

Figure 5: Connecting multiple devices with RS422

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5.2.5 Automatic mode

The analog interface of the LLB is isolated from the rest of the device. When using the analog interface, connect the analog ground (AGND).
Make sure, that the total resistance in the analog path is lower than 500 Ω.

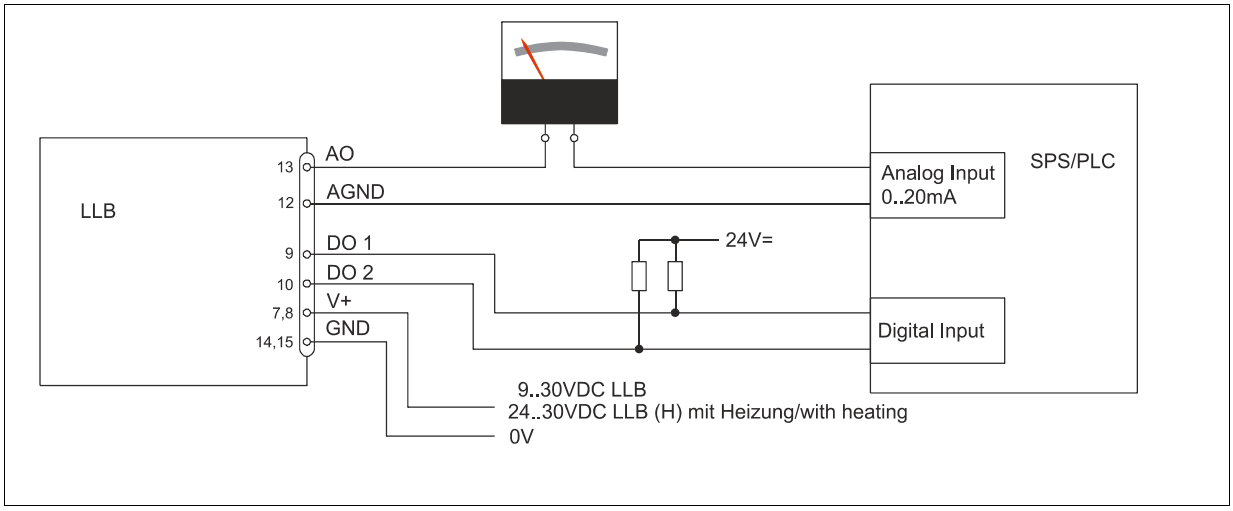

Figure 6: Connection of an instrument and a PLC

5.3 Alignment of the laser beam

Alignment of the laser beam is often difficult when the target is far away, as the laser spot is not visible. An optional telescopic viewfinder is available which simplifies alignment significantly. Please refer to chapter 11 Accessories on page 103 for a description of the viewfinder.

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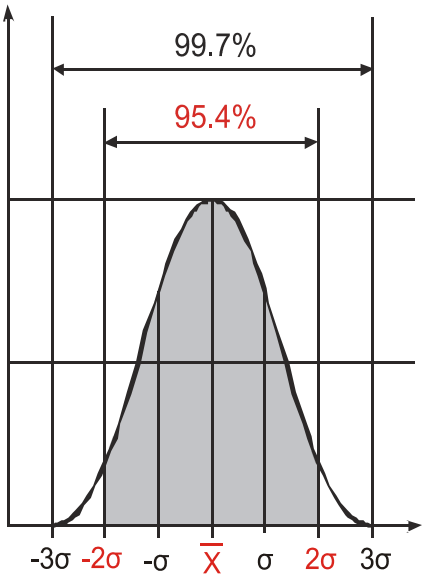
6 Technical data

6.1 Measuring accuracy

The measuring accuracy corresponds to the ISO-recommendation ISO/R 1938-1971 with a statistical confidence level of 95.4 % (i.e. ± twice the standard deviation σ, refer to diagram on the right). The **typical** measuring accuracy relates to average conditions for measuring.



Measuring accuracy	
LLB65-00600	± 1.5 mm
LLB65-00601	± 3 mm
LLB65-00610	± 1.5 mm
LLB65-00611	± 3 mm
LLB500-00600	± 1 mm
LLB500-00601	± 3 mm
LLB500-00610	± 1 mm
LLB500-00611	± 3 mm

The values above are valid in the tracking mode.

The **maximum** measuring error relates to unfavourable conditions such as:

- Highly reflective surfaces (e.g. reflector tapes)
- Operation at the limits of the permitted temperature range, adaptation to ambient temperature canceled
- Very bright ambient conditions, strong heat shimmer

Maximum measuring error	
LLB65-00600	± 2 mm
LLB65-00601	± 5 mm
LLB65-00610	± 2 mm
LLB65-00611	± 5 mm
LLB500-00600	± 2 mm
LLB500-00601	± 5 mm
LLB500-00610	± 2 mm
LLB500-00611	± 5 mm

The LLB does not compensate changes of atmospheric environment. These changes can influence the accuracy if measuring long distances (>150 m) under conditions very different from 20 °C, 60 % relative humidity and 953 mbar air pressure. The influences of the atmospheric environment are described in:

B.Edlen: "*The Refractive Index of Air, Metrologia 2*", 71-80 (1966)

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6.2 Specifications

Typical measuring accuracy for: **LLB65-00600, LLB65-00610** [1] **LLB65-00601, LLB65-00611** [1] **LLB500-00600, LLB500-00610** [1] **LLB500-00601, LLB500-00611** [1]	 ± 1.5 mm at 2 σ ± 3 mm at 2 σ ± 1 mm at 2 σ ± 3 mm at 2 σ
Accuracy of the analog output **LLB-65:** **LLB-500:**	 0.2 % full scale 0.1 % full scale
Smallest unit displayed:	0.1 mm
Measuring range on natural surfaces:	0.05 m to approx. 65 m
Measuring range on orange (reflective) target plate **LLB-500:** **see chapter 11 Accessories on page 103.**	 0.05 m to 500 m
Measuring reference:	from front edge, see 8 Physical dimensions
Diameter of laser spot at target with a distance of:	4 mm at 5 m 8 mm at 10 m 15 mm at 30 m
Time for a measurement: **- Single measurement** **LLB-65 / LLB-500:** **- Tracking** **LLB-65:** **LLB-500:**	 0.3 s to approx. 4 s 0.15 s to approx. 4 s 40 ms to 4 s
Light source:	Laser diode 620-690 nm (red) IEC 60825-1:2001; Class 2 FDA 21CFR 1040.10 and 1040.11 Beam divergence: 0.16 x 0.6 mrad Pulse duration: 0.45×10^{-9} s Maximum radiant power: 0.95 mW
Laser Life Time:	>50'000 h at 20 °C
ESD:	IEC 61000-4-2: 1995 +A1 +A2
EMC:	EN 61000-6-4 EN 61000-6-2
Power supply: **LLB-65/-500:** **LLB-65/-500 (with heating):**	9 ... 30 V DC 0.6 A 24 ... 30 V DC 2.5 A
Dimensions:	150 x 80 x 55 mm
Operation temperature [2]**:** **LLB-65/-500:** **LLB-65/-500 (with heating):**	-10 °C to +50 °C -40 °C to +50 °C
Storage temperature:	-40 °C to +70 °C
Degree of Protection:	IP65; IEC60529 (protected against ingress of dust and water)
Vibration, DIN EN 60068-2-6: 1996	≤ 50 m/s2, sine 50-2000 Hz
Schock, DIN EN 60068-2-27: 1995	≤ 300 m/s2, half-sine 11 ms
Weight: **LLB-65/-500:** **LLB-65/-500 (with heating):**	690 g 720 g
Interfaces:	1 RS232/RS422 interface 1 SSI interface (**only LLB-500**) 1 programmable analog output 0/4 .. 20 mA 2 programmable digital outputs 1 programmable digital input 1 digital output for error status

[1]) See 6.1 Measuring accuracy on page 79.
[2]) In case of permanent continuous measurement (tracking mode) the max. temperature is reduced to 45°C

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7 Electrical components

7.1 ID switch

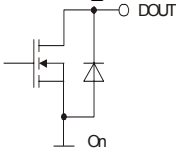
This switch is used to set the module ID and can be set from 0 to 9. Default setting is 0.

7.2 Reset switch

To reset the module to factory settings do the following:

- Switch OFF the power for the module
- Press the reset button and keep it pressed
- Switch on the power for the module with pressed reset button
- Keep the reset button pressed until all LEDs on the module are illuminated
- Release the reset button.
- Switch the power OFF and wait 5 seconds.
- Switch on the power and wait until the green power LED is on.

7.3 Digital output



The LLB contains two digital outputs for level monitoring (DO 1 and DO 2) and one digital output for error signalization (DO E). These outputs are open drain outputs as shown in Figure 7 and can drive up to 200mA. Maximum switching voltage is 30 VDC. In the ON state, the FET transistor is electro conductive.

Figure 7: Open drain output

7.4 Digital Input

The Digital Output (DO 1) can be configured as a Digital Input (DI 1). This is useful for triggering measurements by means of an external switch or push button. Please refer to chapter 10.4 Digital Input on page 96.

Low Level is: $U_{DI1} < 2$ VDC
High Level is: $U_{DI1} > 9$ VDC and $U_{DI1} < 30$ VDC

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7.5 Analog output

The analog output of the LLB is a current source (0..20 mA or 4..20 mA). It is capable of driving loads up to 500 Ω. The analog output has an accuracy of ± 0.2 % for LLB-65 and ± 0.1 % for LLB-500 full scale.

LLB-65:

$$u_{Max} = \frac{Range}{500} = \frac{(Conf_{MaxDist} - Conf_{MinDist})}{500}$$

u_{Max} = max. uncertainty
$Conf_{MaxDist}$ = Distance programmed for the max. output current
$Conf_{MinDist}$ = Distance programmed for the min. output current

LLB-500:

$$u_{Max} = \frac{Range}{1000} = \frac{(Conf_{MaxDist} - Conf_{MinDist})}{1000}$$

u_{Max} = max. uncertainty
$Conf_{MaxDist}$ = Distance programmed for the max. output current
$Conf_{MinDist}$ = Distance programmed for the min. output current

Example:

The configured measurement range is 0...20 m and the actual measured distance is 14 m. This results in a measurement uncertainty of ± 0.04 m (0.2 % of 20 m) for the LLB-65 and ± 0.02 m (0.1 % of 20 m) for the LLB-500, which includes all parameters (temperature drift, sensor accuracy, linearity, target color etc.). The uncertainty decreases, if the ambient temperature is stable.

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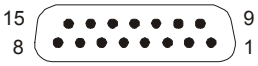
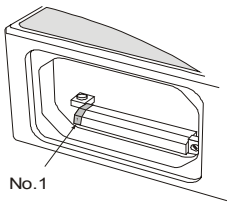
7.6 Connector

7.6.1 D-Sub connector



Pin	Designator	Description
1	**Rx**	RS232 receive line
2	**Tx**	RS232 send line
3	**T-**	- RS422 send line negative - SSI data output negative (only for LLB-500 and if configured for SSI)
4	**T+**	- RS422 send line positive - SSI data output positive -(only for LLB-500 and if configured for SSI)
5	**R-**	- RS422 receive line negative - SSI clock input negative (only for LLB-500 and if configured for SSI)
6	**R+**	- RS422 receive line positive - SSI clock input positive (only for LLB-500 and if configured for SSI)
7 8	**PWR**	DC Power + 9 V…+30 V for LLB +24 V…+30 V for LLB (**with heating**)
9	**DO 1**	Digital output 1 (Open Drain) or Digital input 1
10	**DO 2**	Digital output 2 (Open Drain)
11	**DO E**	Digital output for error signalization (Open Drain)
12	**AGND**	Analog ground
13	**AO**	Analog output (0/4..20 mA)
14	**GND**	Ground line
15	**GND**	Ground line

7.6.2 Screw terminal



Pin	Designator	Description
1	**R+**	- RS422 receive line positive - SSI clock input positive (only for LLB-500 and if configured for SSI)
2	**R-**	- RS422 receive line negative - SSI clock input negative (only for LLB-500 and if configured for SSI)
3	**T+**	- RS422 send line positive - SSI data output positive (only for LLB-500 and if configured for SSI)
4	**T-**	- RS422 send line negative - SSI data output negative (only for LLB-500 and if configured for SSI)
5	**Tx**	RS232 Transmit line
6	**Rx**	RS232 Receive line
7	**AGND**	Analog ground
8	**AO**	Analog output (0/4..20mA)
9	**DO E**	Digital output for error signalization (Open Drain)
10	**DO 2**	Digital output 2 (Open Drain)
11	**DO 1**	Digital output 1 (Open Drain) or Digital input 1
12	**GND**	Ground line
13	**PWR**	Power DC +9 V...+30 V LLB +24 V...+30 V LLB (**with heating**)

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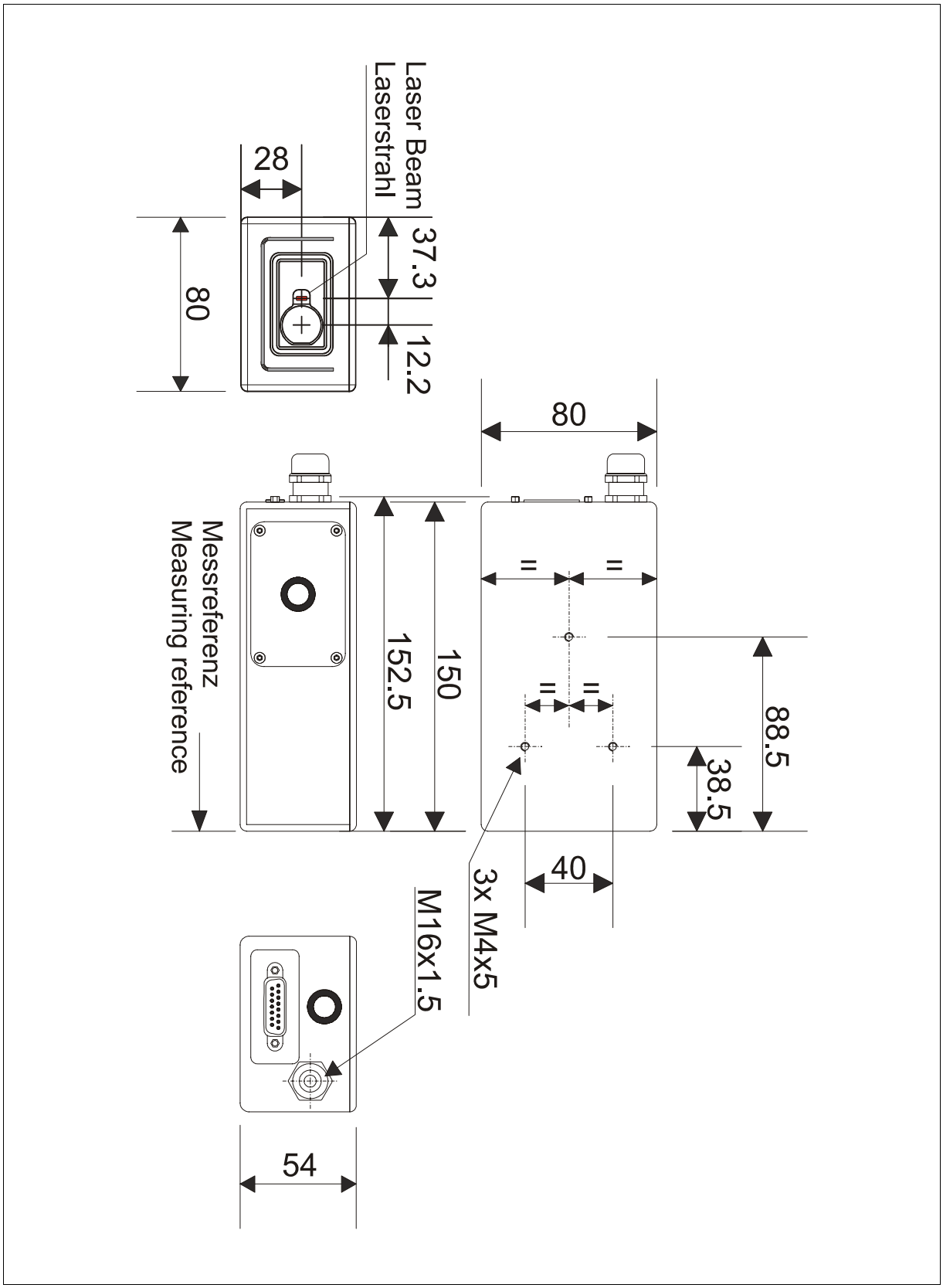
8 Physical dimensions

All dimensions in mm



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9 Factory settings

9.1 Operation

Mode:	Controlled Mode

9.2 Communication parameters

Baud:	19200
Data bit:	7
Parity:	Even
Stop bit:	1

9.3 Analog outputs

Min output:	4 mA
Range min:	0 m
Range max:	10 m
Error output:	0 mA

9.4 Module ID

ID Number:	0

9.5 Digital output 1 (DOUT1)

ON:	2 m + 5 mm	=	2005 mm
OFF:	2 m – 5 mm	=	1995 mm

9.6 Digital output 2 (DOUT2)

ON:	1 m – 5 mm	=	995 mm
OFF:	1 m + 5 mm	=	1005 mm

9.7 Digital input 1 (DI1)

Inactive, configured as output

9.8 User distance offset

User distance offset = 0 mm

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10 Command set

10.1 General

10.1.1 Command termination <trm>

All commands for the LLB are ASCII based and terminated **<trm>** with **<cr><lf>.**

10.1.2 Module identification *N*

Since the module can be addressed with the ID switch, the ID is represented in the commands by *N*. At the location of the *N* insert the Module ID.

10.1.3 Parameter separator

The command syntax uses the '+' sign as parameter separator. The '+' sign can be replaced by the minus '–' sign if applicable by the command.

10.1.4 Set/Get Commands

All configuration commands that are used to set configuration values can also be used to read the currently set value by omitting the parameter. The command syntax is described as follows:

	Set Command	Get Command
Command	s*N*uof+xxxxxxxx<trm>	s*N*uof<trm>
Return successful	g*N*of?<trm>	g*N*uof+*xxxxxxxx*<trm>
Return Error	g*N*@E*zzz*<trm>	g*N*@E*zzz*<trm>
Parameters	*N* Module ID (0..9) xxxxxxxx Offset in 1/10 mm; + positive / - negative zzz Error code	

10.1.5 Startup sequence

After power on the LLB does all the initializations and sends a start sequence g*N*?. On this sequence, the *N* stands for the Module ID. After sending this start sequence, the LLB is ready to use.

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10.2 Operation commands

10.2.1 STOP/CLEAR command (sNc)

Stops the current execution and resets the status LEDs as well as the digital outputs.

	Command	
Command	sNc<trm>	
Return successful	gN?<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) zzz Error code	

10.2.2 Distance measurement (sNg)

Triggers simple measurement of distance. Each new command cancels an active measurement.

	Command	
Command	sNg<trm>	
Return successful	gNg+xxxxxxxx<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) xxxxxxxx Distance in 1/10 mm zzz Error code	

10.2.3 Signal measurement (sNm)

Signal measurement can be done continuously or with a single measurement. The signal strength is returned as a relative number in the range of 0 to 8 million.

	Command	
Command	sNm+c<trm>	
Return successful	gNm+xxxxxxxx<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) c 0: single measurement 1: repetitive measurement ⚠ Use only with one sensor! xxxxxxxx Signal strength (range 0.. 8 millions) zzz Error code	

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10.2.4 Temperature measurement (sNt)

Triggers measurement of the temperature inside the sensor.

	Command	
Command	s*N*t<trm>	
Return successful	g*N*t+*xxxxxxxx*<trm>	
Return Error	g*N*@E*zzz*<trm>	
Parameters	*N* Module ID (0..9) xxxxxxxx Temperature in 0.1°C zzz Error code	

10.2.5 Laser ON (sNo)

Switches laser beam ON for easy adjustment.

	Command	
Command	s*N*o<trm>	
Return successful	g*N*?<trm>	
Return Error	g*N*@E*zzz*<trm>	
Parameters	*N* Module ID (0..9) zzz Error code	

10.2.6 Laser OFF (sNp)

Switches laser OFF.

	Command	
Command	s*N*p<trm>	
Return successful	g*N*?<trm>	
Return Error	g*N*@E*zzz*<trm>	
Parameters	*N* Module ID (0..9) *zzz* Error code	

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10.2.7 Single sensor, Tracking (sNh)

WARNING !

- ***Danger of physical injury and damage to property by undefined interface states !***
  - Never use this command if more than one module is connected to the RS232/RS422 line

Triggers continuous measurement of the distance. This command is not to be used with more than one LLB on the RS-232/RS-422 line. The measurements are continued until the STOP/CLEAR command (sNc) is issued. The status LEDs and the digital outputs are updated corresponding to the new measured distance.

	Command	
Command	sNh<trm>	
Return successful	gNh+xxxxxxxx<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) xxxxxxxx Distance in 0.1 mm zzz Error code	

10.2.8 Tracking with buffering – Start (sNf)

Triggers continuous measurement of the distance with internal buffering in the module (buffer for one measurement). The rate of measurements is defined with the sampling time. If the sampling time is set to zero, the measurements are executed as fast as possible. The last measurement can be read out from the module with the command sNq. The measurements are continued until the 'sNc' command is issued.

	Set Command	Get Command
Command	sNf+xxxxxxxx<trm>	sNf<trm>
Return successful	gNf?<trm>	gNf+xxxxxxxx<trm>
Return Error	gN@Ezzz<trm>	gN@Ezzz<trm>
Parameters	N Module ID (0..9) xxxxxxxx Sampling rate in 10 ms (if 0 -> max possible rate) zzz Error code	

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10.2.9 Read out - Tracking with buffering (sNq)

After starting “tracking with buffering” with the command sNf, the last measurement can be read out from the module with the command sNq.

	Command	
Command	sNq<trm>	
Return successful	gNq+xxxxxxxx+c<trm>	
Return Error	gN@Ezzz+c<trm>	
Parameters	N Module ID (0..9) xxxxxxxx Distance in 0.1 mm c 0 = no new measurement since last sNq command 1 = one new measurement since last sNq command, not overwritten 2 = more than one measurement since last sNq command, overwritten zzz Error code	

10.3 Configuration commands

10.3.1 Set/Get communication parameter (sNbr)

Sets the communication parameters for the serial interface.

This command saves all configuration parameters to Flash.
The changed baud rate is activated after the next power on.

Bold = default parameters (first use or after reset)

	Command	
Command	sNbr+y<trm>	
Return successful	gN?<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) y Defines the new settings	

%	Baud rate	Data bit	Parity
0	1200	8	N
1	9600	8	N
2	19200	8	N
3	1200	7	E
4	2400	7	E
5	4800	7	E

%	Baud rate	Data bit	Parity
6	9600	7	E
7	**19200**	**7**	**E**
8	38400	8	N
9	38400	7	E
10	115200	8	N
11	115200	7	E

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10.3.2 Set automatic mode (sNA)

This command activates the automatic mode of the LLB. It triggers continuous measurement of the distance and sets the analog and digital outputs according to the measured distance values. The rate of measurements is defined with the sampling time. If the sampling time is set to zero, the measurements are executed as fast as possible.

The automatic mode is active until the sNc command is issued.

- The operating mode is stored in the LLB and activated immediately. This mode is also activated after next power ON.
- Internally “tracking with buffering” is started (command sNf). Therefore the last measurement can also be read out from the module with the command sNq.

	Command	
Command	sNA+xxxxxxxx<trm>	
Return successful	gNA?<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) xxxxxxxx Sampling time in 10 ms (if 0 -> max possible rate) zzz Error code	

10.3.3 Set/Get analog output min level (sNvm)

This command sets the minimum analog output current level (0 or 4 mA).

	Set Command	Get Command
Command	sNvm+x<trm>	sNvm<trm>
Return successful	gNvm?<trm>	gNvm+x<trm>
Return Error	gN@Ezzz<trm>	gN@Ezzz<trm>
Parameters	N Module ID (0..9) x Minimum output for analog out 0: 0 mA 1: 4 mA zzz Error code	

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10.3.4 Set/Get analog output value in error case (sNve)

This command sets the analog output current level in mA in case of an error. This level can be lower than the minimum level set in 10.3.3 Set/Get analog output min level (sNvm).

	Set Command	Get Command
Command	sNve+xxx<trm>	sNve<trm>
Return successful	gNve?<trm>	sNve+xxx<<trm>
Return Error	gN@Ezzz<trm>	gN@Ezzz<trm>
Parameters	N Module ID (0..9) xxx Value in case of an error in 0.1mA zzz Error code	

10.3.5 Set/Get distance range (sNv)

Sets the minimum and maximum distances corresponding to the minimum and maximum analog output current levels.

0...20 mA

$$Aout = \frac{DIST - D_{min}}{D_{max} - D_{min}} * 20\,mA$$

4...20 mA

$$Aout = \frac{DIST - D_{min}}{D_{max} - D_{min}} * 16\,mA + 4\,mA$$

Aout	Analog current output
DIST	Actual measured distance
D_{min}	Distance programmed for the minimum output current
D_{max}	Distance programmed for the maximum output current

	Set Command	Get Command
Command	sNv+xxxxxxxx+yyyyyyyy<trm>	sNv<trm>
Return successful	gNv?<trm>	gNv+xxxxxxxx+yyyyyyyy<trm>
Return Error	gN@Ezzz<trm>	gN@Ezzz<trm>
Parameters	N Module ID (0..9) xxxxxxxx Minimum distance in 1/10 mm corresponding to 0 mA / 4 mA yyyyyyyy Maximum distance in 1/10 mm corresponding to 20 mA zzz Error code	

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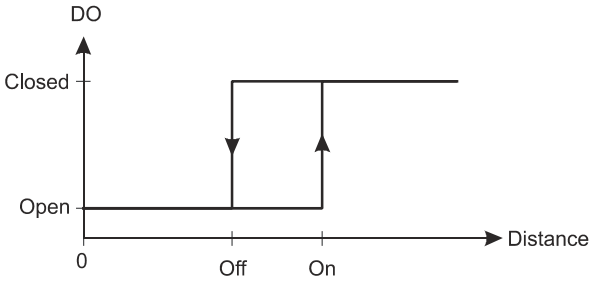
10.3.6 Set/Get digital output levels (sNn)

Sets the distance levels at which the digital outputs are switched ON and OFF with a hysteresis.

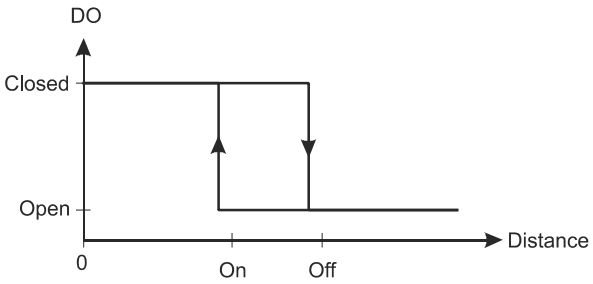
Two different situations are possible:

ON Distance > OFF Distance



The ON level of the hysteresis is larger than the OFF level. With an increasing distance, the digital output is switched on (open drain output is closed) when the distance exceeds the ON level. With a decreasing distance, the digital output is switched off (open drain output is open) when the distance falls below the OFF level.

ON Distance < OFF Distance



The ON level of the hysteresis is smaller than the OFF level. With a decreasing distance, the digital output is switched on (open drain output is closed) when the distance falls below the ON level. With an increasing distance, the digital output is switched off (open drain output is open) when the distance exceeds the OFF level.

	Set Command	Get Command
Command	s*Nn*+*xxxxxxxx*+*yyyyyyyy*<trm>	s*Nn*<trm>
Return successful	g*Nn*?<trm>	g*Nn*+*xxxxxxxx*+*yyyyyyyy*<trm>
Return Error	g*N*@E*zzz*<trm>	g*N*@E*zzz*<trm>
Parameters	*N* Module ID (0..9) *n* Digital output port (1 or 2) *xxxxxxxx* Distance ON level in 1/10 mm for switching digital output ON *yyyyyyyy* Distance OFF level in 1/10 mm for switching digital output OFF *zzz* Error code	

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10.3.7 Save configuration parameters (sNs)

This command saves all configuration parameters, which are set by the commands above. The parameters are written to the Flash Memory.

	Command	
Command	sNs<trm>	
Return successful	gNs?<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) zzz Error code	

10.3.8 Set configuration parameters to factory default (sNd)

This command restores all configuration parameters to their factory default values. The parameters are written to the Flash Memory.

The communication parameters are also reset to factory settings.

	Command	
Command	sNd<trm>	
Return successful	gN?<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) zzz Error code	

10.3.9 Get Software Version (sNsv)

Retrieves the software version of the LLB.

	Command	
Command	sNsv<trm>	
Return successful	gNsv+xxxxyyyy<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) xxxx Module software version yyyy Interface software version zzz Error code	

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10.3.10 Get Serial Number (sNsn)

Retrieves the serial number.

	Command	
Command	sNsn<trm>	
Return successful	gNsn+xxxxxxxx<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) xxxxxxxx Serial number of the device zzz Error code	

10.3.11 Get device generation and type (dg)

This command returns the device type, generation and current communication settings.

	Command	
Command	dg<trm>	
Return successful	gNdg+xxx+yz?<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) xxx Bit coded number to identify the device: 0x53 (83) LLB-65 y not used z Comunication settings (see command sNbr+C) zzz Error code	

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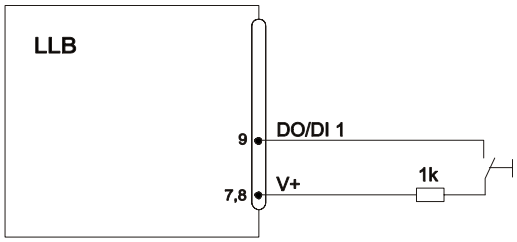
10.4 Digital Input



The following commands configure the terminal DO1. This port can also be used as digital input. For safety reasons, always use a resistor to protect the connection terminal.

10.4.1 Configure digital input (sNDI1)

The digital output 1 of the LLB can also be used as digital input. Its state can be read or trigger a configurable action. Use the following command to configure the behavior of the digital input.

On active digital input, the digital output function of DO1 is deactivated.

	Set Command	Get Command
Command	sNDI1+xxxxxxxx<trm>	sNDI1<trm>
Return successful	gNDI1?<trm>	sNDI1+xxxxxxxx<trm>
Return Error	gN@Ezzz<trm>	gN@Ezzz<trm>
Parameters	N Module ID (0..9) xxxxxxxx 0: Digital input inactive (DO1 active) 1: activate the digital input to read out its state with the command 10.4.2 Read digital input (sNRI). 2: Trigger Distance measurement (sNg) 3: Start/Stop Single sensor Tracking (sNh) 4: Start/Stop Tracking with buffering (sNf) zzz Error code	

10.4.2 Read digital input (sNRI)

Displays the state of the digital input, if the input is not inactive.

	Command	
Command	sNRI<trm>	
Return successful	gNRI+x<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) x 0: Input Off (Signal Low) 1: Input On (Signal High) zzz Error code	

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10.5 SSI (Synchronous serial interface)

Only implemented in the LLB-500.

10.5.1 Change from RS422 to SSI output and back (s*N*SSI)

If the SSI interface should be used at the same port where normally the RS422 resides, it can be switched. This setting will only be activate until next power OFF. To keep it, use the sNs command.

	Set Command	Get Command
Command	s*N*SSI*+c*<trm>	s*N*SSI<trm>
Return successful	g*N*SSI?<trm>	g*N*SSI*+c*<trm>
Return Error	g*N*@E*zzz*<trm>	g*N*@E*zzz*<trm>
Parameters	*N* Module ID (0..9) *c* 0: switch to (or stay in) RS422 mode 1: switch to (or stay in) SSI mode *zzz* Error code	

10.5.2 Set/Get error value on SSI output (sNSSIe)

In measuring error case, the SSI output will have the value, which is stored as the SSI error value. To change it, the sNSSIe command can be used: The value can be in the range (0…16777215). This value will will only be available until next power OFF. To keep it, use the sNs command.

	Set Command	Get Command
Command	s*N*SSIe*+xxxxxxxx*<trm>	s*N*SSIe<trm>
Return successful	g*N*SSIe?<trm>	g*N*SSIe*+xxxxxxxx*<trm>
Return Error	g*N*@E*zzz*<trm>	g*N*@E*zzz*<trm>
Parameters	*N* Module ID (0..9) *xxxxxxxx* A value within 0 and 16777215. *zzz* Error code	

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10.6 Special User Commands

The special user commands can be configured by the user and are an extension to the standard commands. Use these commands carefully and only if you really understand what they do.

10.6.1 Set/Get user distance offset (sNuof)

The user can set an individual overall offset correction for all distance measurement commands in this 'Special User Command' section. The standard distances measurement commands are not involved.

	Set Command	Get Command
Command	sNuof+xxxxxxxx<trm>	sNuof<trm>
Return successful	gNof?<trm>	gNuof+xxxxxxxx<trm>
Return Error	gN@Ezzz<trm>	gN@Ezzz<trm>
Parameters	N Module ID (0..9) xxxxxxxx Offset in 1/10 mm; + positive / - negative zzz Error code	

10.6.2 User configured distance measurement (sNug)

Triggers simple distance measurement, similar to the command 10.2.2 Distance measurement (sNg) on page 87. This command returns the distance corrected with the user offset (and user gain) as set with the command 10.6.1 Set/Get user distance offset (sNuof). Each new command cancels an active measurement.

This command takes the user distance offset into account (sNuof).

	Command	
Command	sNug<trm>	
Return successful	gNug+xxxxxxxx<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) xxxxxxxx Distance in 0.1 mm zzz Error code	

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10.6.3 User-configured single sensor tracking (sNuh)

WARNING !

- ***Danger of physical injury and damage to property by undefined interface states !***
  - Never use these commands if more than one module is connected to the RS232/RS422 line

Triggers continuous measurement of the distance and outputs the result immediately to the serial interface. The measured distance is corrected with the user offset (and user gain) as set with the command 10.6.1 Set/Get user distance offset (sNuof). Since the LLB returns the result directly after completing a measurement, never use this command if more than one device is connected to the serial line. The measurements are continued until the stop/clear command (sNc) is issued. Each measurement updates the status LED's and the digital outputs.

This command takes the user distance offset into account (sNuof).

	Command	
Command	sNuh<trm>	
Return successful	gNuh+xxxxxxxx<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) xxxxxxxx Distance in 0.1 mm zzz Error code	

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10.6.4 User-configured tracking with buffering – Start (sNuf)

Triggers continuous measurement of the distance with internal buffering in the module (buffer for one measurement). The measured distance is corrected with the user offset (and user gain) as set with the command 10.6.1 Set/Get user distance offset (sNuof). Define the rate of measurements with the sampling time. If the sampling time is set to zero, the measurements are executed as fast as possible. The last measurement can be read out from the module with the command sNuq. The measurements are continued until the STOP/CLEAR command (sNc) is issued.

This command takes the user distance offset into account (sNuof).

	Set Command	Get Command
Command	sNuf+xxxxxxxx<trm>	sNuf<trm>
Return successful	gNuf<trm>	gNuf+xxxxxxxx<trm>
Return Error	gN@Ezzz<trm>	gN@Ezzz<trm>
Parameters	N Module ID (0..9) xxxxxxxx Sampling time in 10 ms (if 0 -> use max. possible sample rate) zzz Error code	

10.6.5 Read out – User-configured tracking with buffering (sNuq)

After starting “User-configured tracking with buffering” with the command sNuf, the last measurement can be read out from the LLB with the command sNuq.

This command takes the user distance offset into account (sNuof).

	Command	
Command	sNuq<trm>	
Return successful	gNuq+xxxxxxxx+c<trm>	
Return Error	gN@Ezzz+c<trm>	
Parameters	N Module ID (0..9) xxxxxxxx Distance in 0.1 mm c 0 = no new measurement since last sNuq command 1 = one new measurement since last sNuq command, not overwritten 2 = more than one measurement since last sNuq command, overwritten zzz Error code	

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10.6.6 Set user configured automatic mode (sNuA)

This command activates the user automatic mode of the LLB. It triggers continuous measurement of the distance and sets the analog and digital outputs according to the measured distance values. The rate of measurements is defined with the sampling time. If the sampling time is set to zero, the measurements are executed as fast as possible.

In difference to the command sNA, this command returns measuring results according to the user parameters.

The automatic mode is active until the sNc command is issued.

- The operating mode is stored in the LLB and activated immediately. This mode is also activated after next power ON.
- Internally “tracking with buffering” is started (command sNuf). Therefore the last measurement can also be read out from the module with the command sNuq.

	Command	
Command	sNuA+xxxxxxxx <trm>	
Return successful	gNuA?<trm>	
Return Error	gN@Ezzz<trm>	
Parameters	N Module ID (0..9) xxxxxxxx Sampling time in 10ms (if 0 -> use max. possible sample rate) zzz Error code	

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10.7 Error codes

No.	Format	Meaning
203	@E203	Wrong syntax in command, prohibited parameter in command entry or non-valid result
210	@E210	Not in tracking mode, start tracking mode first.
211	@E211	Sampling too fast, set the sampling time to a larger value.
212	@E212	Command cannot be executed, because tracking mode is active, first use command sNc to stop tracking mode.
220	@E220	Communication error
230	@E230	Distance value overflow caused by wrong user configuration. Change user offset (and/or user gain)
231	@E231	Wrong mode for digital input status read.
232	@E232	Digital output 1 cannot be set if configured as digital input
233	@E233	Number cannot be displayed, check output format.
234	@E234	Distance out of range
236	@E236	Digital output manual mode (DOM) cannot be activated when configured as digital input
252	@E252	Temperature too high (contact TR-Electronic if error occurs at room temperature)
253	@E253	Temperature too low (contact TR-Electronic if error occurs at room temperature)
254	@E254	Bad signal from target It takes too long to measure according distance
255	@E255	Received signal too weak, distance (Use different target and distances, if the problem persists, please contact TR-Electronic)
256	@E256	Received signal too strong (Use different targets and distances, if the problem persists, please contact TR-Electronic)
257	@E257	Too much background light (Use different target and distances, if the problem persists, please contact TR-Electronic)
258	@E258	Power supply is too high
260	@E260	Distance cannot be calculated because ambiguous targets. Use clear defined targets to measure the distance.
360	@E360	Measuring time is too short
361	@E361	Measuring time is too long
not listed		Hardware failure (Contact TR-Electronic)

Before contacting TR-Electronic, please collect as much information as possible.

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11 Accessories

11.1 Viewfinder

The telescopic viewfinder can be used for easy alignment of the LLB for long distances. Clip the support onto the case of the LLB.

Part Number	Description	
On request	Telescopic viewfinder	

11.2 Target plates

The target plates provide a defined measuring target. Color orange reflective, for measuring longer distances from about 30 m. The reflective surface sends more light back to the LLB. These target plates work over distances from 0.05 to 500 m.

Part Number	Description	
49.500.040	Aluminium target plate orange reflective, 210 x 297 mm	

11.3 Laser glasses

The red lens glasses improve visibility of the laser dot under bright environment conditions. They can be used for distances up to 10-20 m.

Part Number	Description	
On request	Laser glasses	

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11.4 Connection set

Part Number	Description
62.205.009	Connection set

11.5 Connector cover IP65

If the LLB is connected via the cable gland and the 15 pin D-Sub connector is not used, this cover protects the 15 pin D-Sub connector.

Part Number	Description	
49.500.041	Connector cover IP65	

11.6 Connector with 90° cable exit IP65

The connector allows the connection of the LLB with IP65 protection.

Part Number	Description	
620.001.464	Connector 90° IP65	

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